POWER ELECTRONICS

APPLICATION NOTE

ME60 Family
External Power Supplies
IEC60601-1-2 4th Edition Compliant

AN-P010/16

Overview

The SL Power ME Family of external power supplies are designed to comply with the IEC60601-1-2 4th edition collateral standard for Electromagnetic disturbances. Although this is a system level standard, the power adapter is the interface between the medical device and the AC power source, and is an essential component in the path to achieving compliance to the standard.

SL Power Electronics has taken the lead in developing and providing IEC60601-1-2 4th edition compliant power adapters. In addition, the ME series of adapters also has leading edge power conversion efficiency to reduce component temperatures, extend product use life and reduce energy consumption. The ME series adapters meet the U.S. Department of Energy (DoE) Level VI efficiency and No Load power consumption requirement.

The ME Series IEC60601-1-2 4th edition has enhanced Electro-Magnetic Compatibility (EMC) features offering increased Electrostatic Discharge (ESD) protection, AC mains surge and RF immunity, resulting in a more robust and reliable product. The ME model's AC mains emissions comply with FCC & EN55011 class B levels with margin. Output emissions for differential ripple and common mode voltage and current have been reduced to minimize system level Electromagnetic Interference (EMI) and system circuit interference.

For long term reliability, this model family has been designed using high quality components to provide long life, thoroughly tested and approved by regulatory agencies. See the product datasheet for more details.

This application note provides guidance for proper use, selection criteria, system design consideration and key performance data. Additional performance data is available upon request.

Proper Use

The external power supplies have high power conversion efficiency, however they do rely on convection cooling to the surrounding environment (air) to prevent overheating or excessive internal and external surface temperatures. Therefore, there needs to be adequate access to ambient air to ensure proper thermal performance of the power supply.

- Do not cover the power supply with blankets, clothing, pillows, or any other poor thermal conductor.
- Do not immerse the power supply in any liquid
- Avoid dropping the power supply on hard surfaces
- Avoid impacting the case of the power supply with any hard object
- Use the proper input cord (desktop version) for the power supply
- Use a proper mating connector for connection to the output of the power supply.
- Do not exceed the power rating of the product.
- Do not place adapter on body parts. This is not considered an "applied part". Surface temperature increase with increased ambient temperature and loading.

Performance Verification

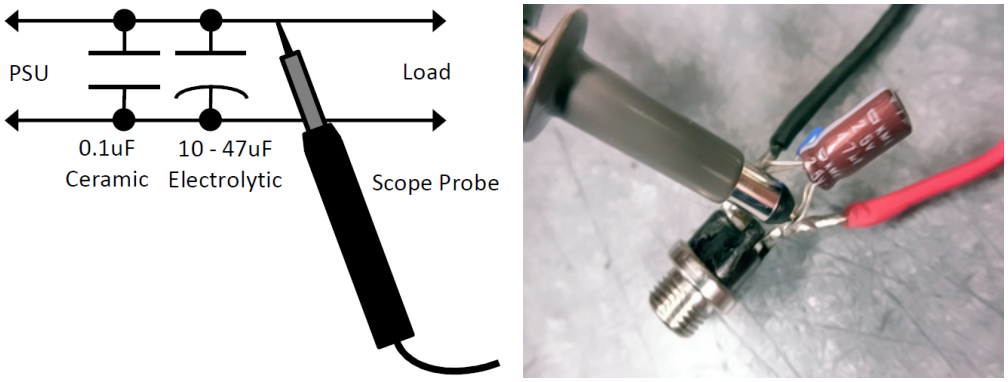
Efficiency and No Load Power

- When measuring efficiency, care must be taken to minimize input and output connection voltage drops, as these can significantly affect the results of the measurement. Consult SL Power application notes AN-G001 and AN-G002 for more information regarding efficiency and no load power measurements.

Output Ripple and Noise

- Output noise and ripple limits are defined in the product datasheet and may vary depending on the output voltage. Consult the product datasheet prior to assessing the output ripple and noise measurement results.
- Noise measurements are made at the output connector with typically a 10uF electrolytic capacitor in parallel with a 0.1uF ceramic capacitor. Use a short tip oscilloscope voltage probe when making the measurement. This is required to eliminate measurement error due to impedance imbalance errors introduced by the scope probe ground lead length.

FIGURE 1: Noise measurement caps and probe with picture of the technique.



- Common mode noise is an electrical signal that appears between either output and earth ground or chassis ground. This comes about due to parasitic capacitance and inductive coupling in the power supply that couples electrical energy from the primary to the secondary or from the secondary to earth ground. Although the coupling is minimized by design and construction, it cannot simply be eliminated. Be aware of any special needs in the application for low common mode noise. The Class I AC input models have lower common mode noise in general and in some cases, where the output can be connected to AC/earth ground, it can be virtually eliminated.

Load and Noise Filtering Capacitors

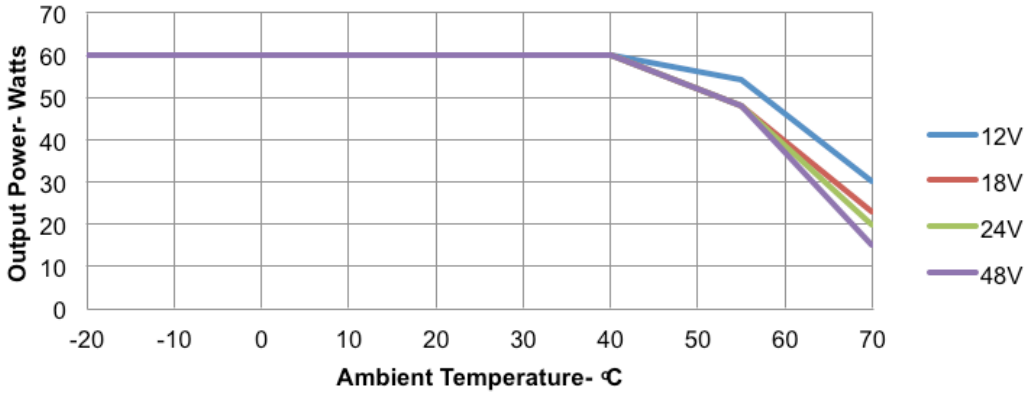
- The external adapters have output filtering capacitors to minimize the switching frequency voltage ripple and noise that is an artifact of the switching power conversion process. However, additional end load capacitance may be needed, depending on the application. With an electronic circuit as the load, it is recommended to add ceramic capacitors (~ 0.1 – 1uF) for noise spike reduction and an electrolytic capacitor for ripple reduction and transient response voltage dip

reductions. The amount of voltage dip during a transient is a function of the load step amplitude and rise/fall time of the load. The output of the power adapter is regulated in the adapter and does not compensate for the output cable voltage drop. The overall load regulation specified is measured at the adapter output connector, however.

Thermal

- No special cooling requirements are needed other than operating within the specified operating temperature range and locating the external power adapter in an environment with unencumbered access to the room ambient air.
- Adhere to the product datasheet derating curve when exposure to elevated temperatures is expected.

FIGURE 2: ME60 family derating curve.



Reliability and Robustness

The external power supply is often handled and not permanently fixed to a structure. They could be dropped on various surfaces, which can cause impact shock damage to the enclosure or internal components. To help assess the potential of damage, shock and vibration requirements should be specified and verified. Low-cost products often use low-cost materials and components that can limit the life of the power supply or result in permanent damage if dropped onto a hard surface.

SL Power provides a higher level of quality and protection to impact shock.

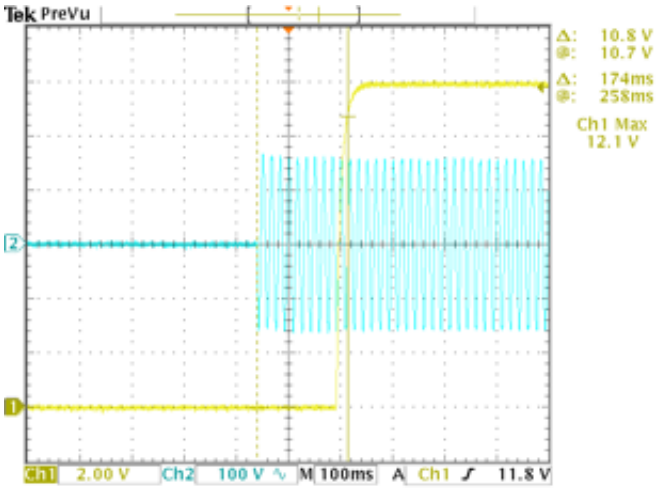
Electrolytic capacitors are one of the main life-limiting components used in the power supply. Selecting high-quality capacitors with high-life ratings are essential to achieving long product life in excess of 7 to 10 years. SL Power Electronics uses only high quality electrolytic capacitors in its ME60 model family. Calculations and measurements are performed to verify capacitor ripple current, voltage and thermal stress and lifetime estimations.

Performance Data

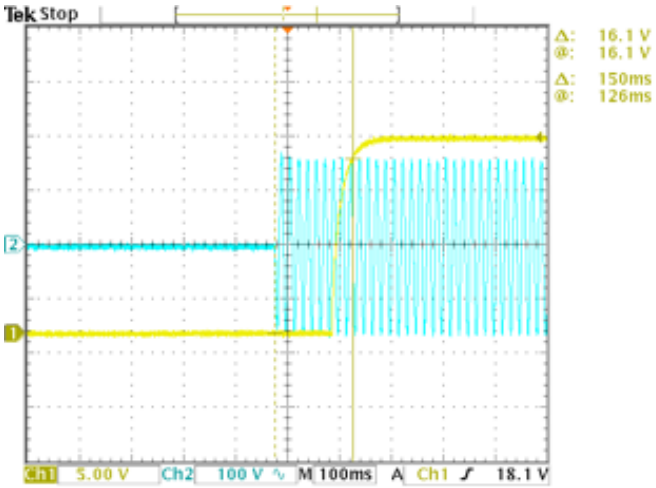
The following data is provided to aid in proper selection and system design. Additional performance data is available upon request.

Turn-On Time:

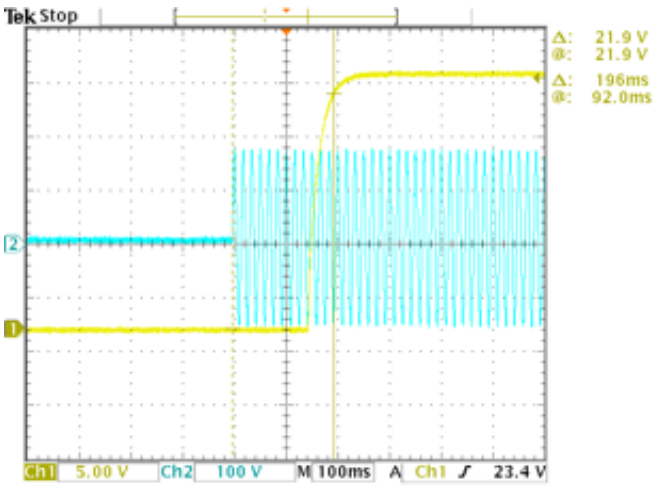
Start-up Turn-On Delay Time; typical turn-on times are shown below for various models.



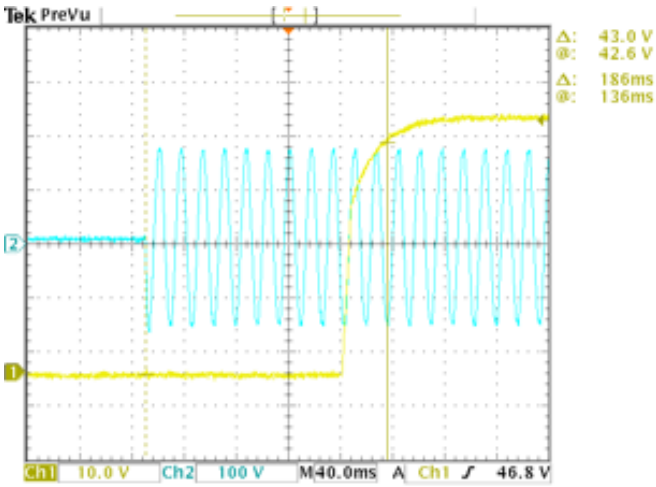
12V Turn-on delay, 115VAC



18V Turn-on delay, 115VAC



24V Turn-on delay, 115VAC

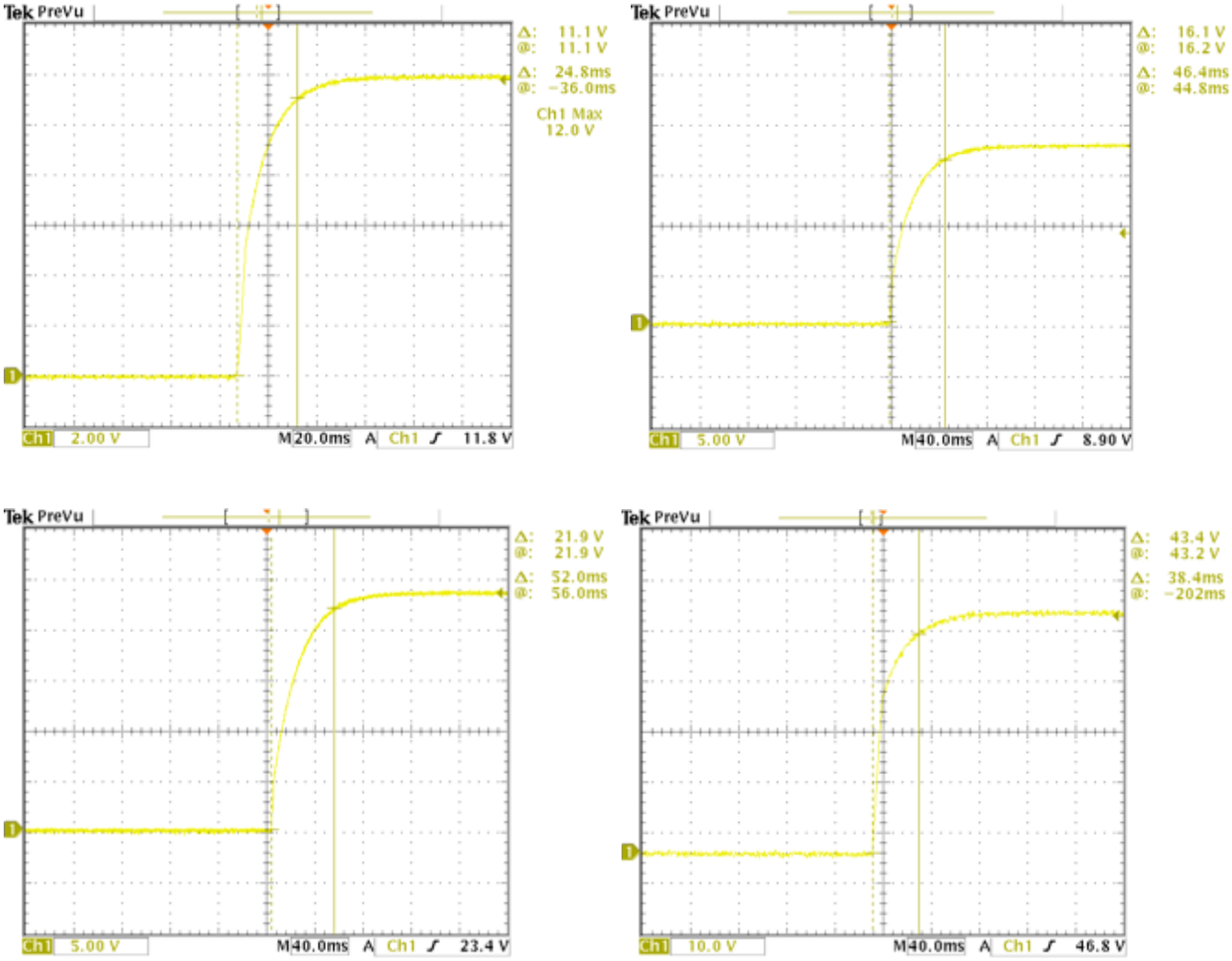


48V Turn-on delay, 115VAC

FIGURE 3: Turn-on delays for various models.

Output Rise Time after Turn-On Delay:

Turn on rise time is slightly impacted by line and load. The data provided shows the slowest rise time which occurs at 90VAC and full load.



12V Rise Time

18V Rise Time

24V Rise Time

48V Rise Time

FIGURE 4: Rise times for various models.

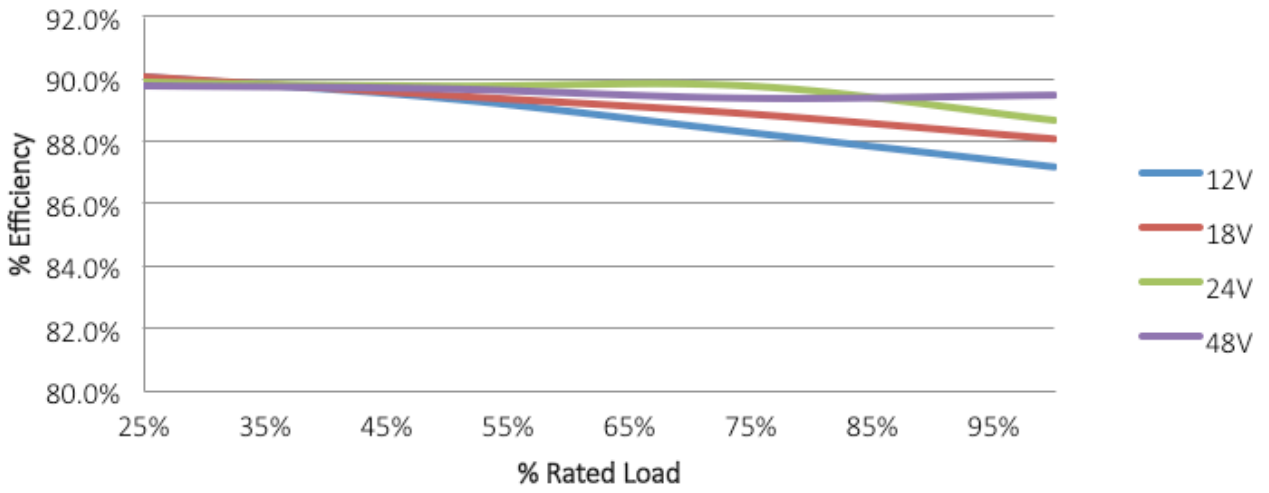
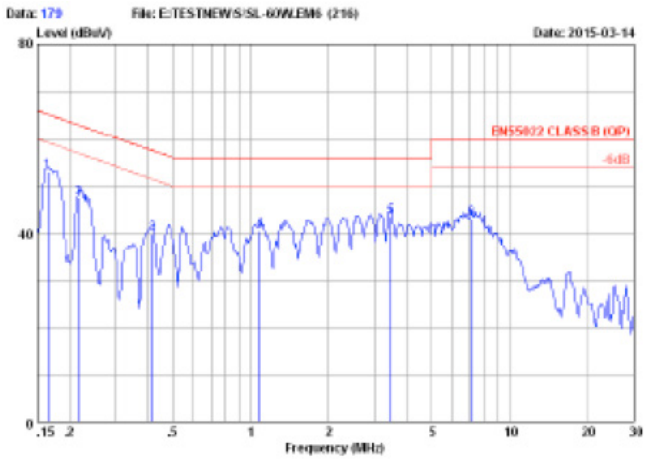


FIGURE 5: ME60 Series Efficiency @ 115VAC.

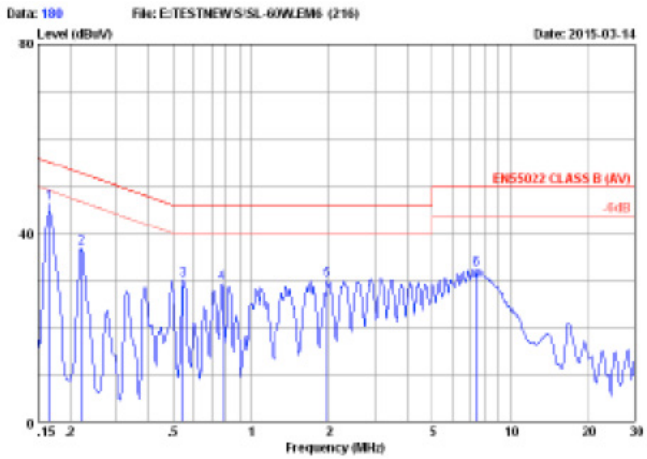
Electromagnetic Interference Data (EMI): Conducted emissions

- EMI plots and data were collected at 10%, 50% and 100% at 100VAC/60Hz and 230VAC 50 Hz. Excerpts are shown in this application note provided typical EMI performance. The plots shown are full load, 230V/50Hz and 100V/60 Hz. The Curve is the peak measured data with Quasi-peak (QP) and Average measurements taken at peak values near the limit. The QP and Average value point data are not shown in these plots, but detailed EMI reports are available upon request.

Electromagnetic Interference Data	
CE EMI 60W 12V CLASS I (F)	



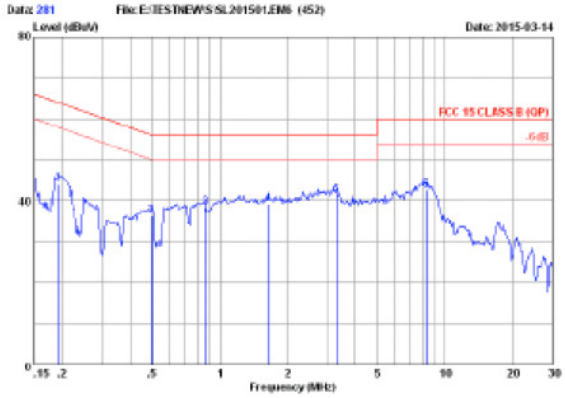
CISPR22 CLASS B QP 230V/50Hz 100% LOAD MARGIN: >12 dB



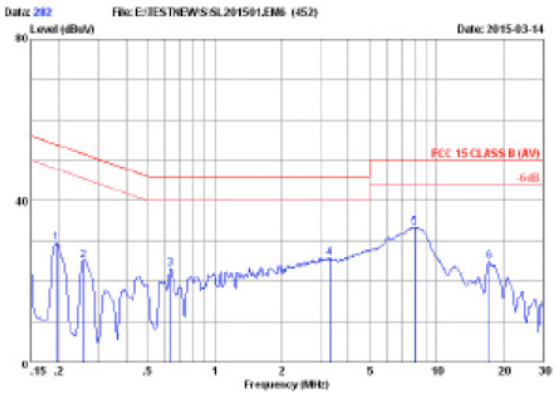
CISPR22 CLASS B AV 230V/50Hz 100% LOAD MARGIN: >8 dB

Electromagnetic Interference Data

CE EMI 60W 12V CLASS I (F)

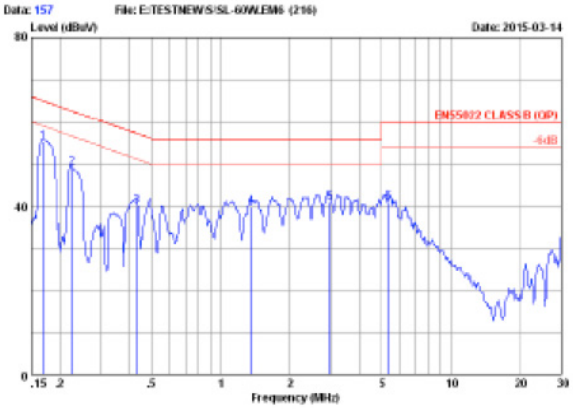


FCC15 CLASS B QP 120V/60Hz 100% LOAD
MARGIN: >14 dB

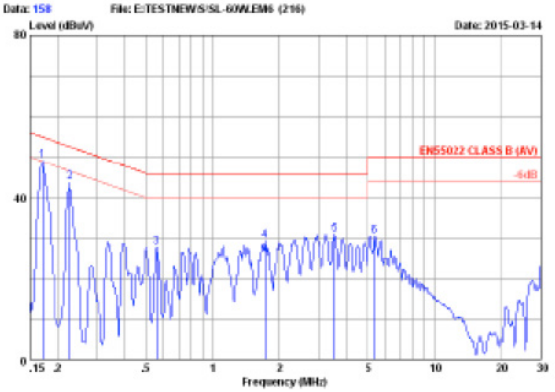


FCC15 CLASS B AV 120V/60Hz 100% LOAD
MARGIN: >16 dB

CE EMI 60W 12V CLASS II (N)



CISPR22 CLASS B QP 230V/50Hz 100% LOAD
MARGIN: >9 dB

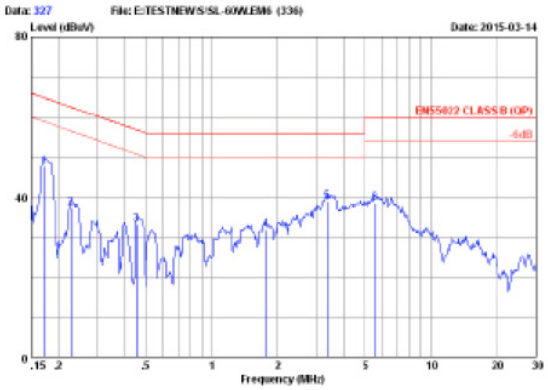


CISPR22 CLASS B AV 230V/50Hz 100% LOAD
MARGIN: >5 dB

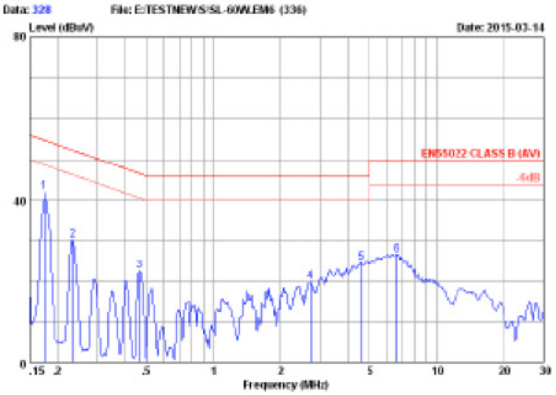
FCC15 CLASS B QP 120V/60Hz 100% LOAD
MARGIN: >14 dB

FCC15 CLASS B AV 120V/60Hz 100% LOAD
MARGIN: >17 dB

CE EMI 60W 18V CLASS I (F)



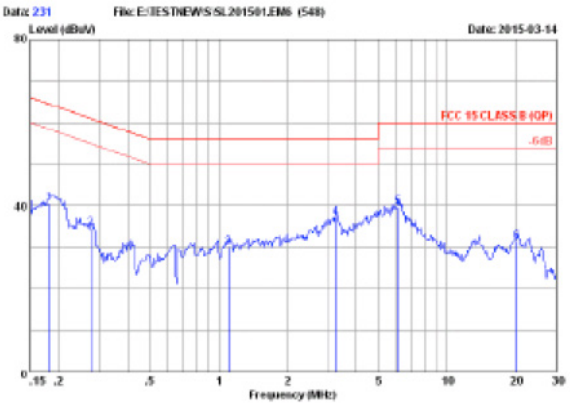
CISPR22 CLASS B QP 230V/50Hz 100% LOAD
MARGIN: >17 dB



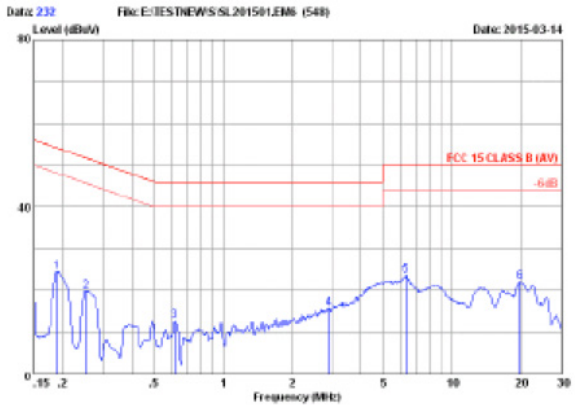
CISPR22 CLASS B AV 230V/50Hz 100% LOAD
MARGIN: >12 dB

Electromagnetic Interference Data

CE EMI 60W 18V CLASS I (F)

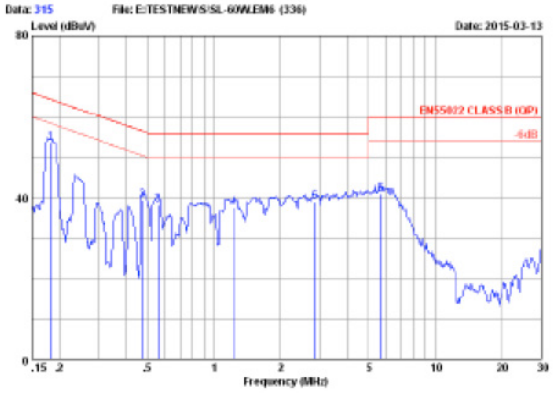


FCC15 CLASS B QP 120V/60Hz 100% LOAD
MARGIN: >18 dB

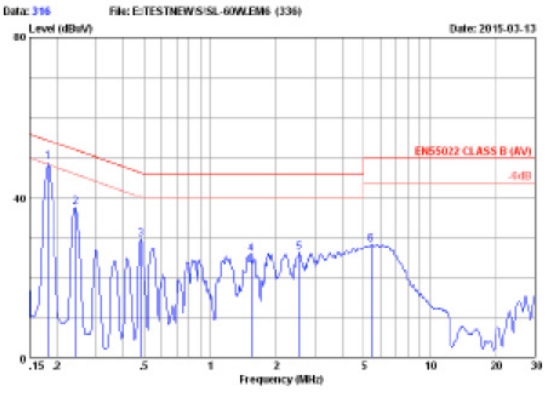


FCC15 CLASS B AV 120V/60Hz 100% LOAD
MARGIN: >26 dB

CE EMI 60W 18V CLASS II (N)



CISPR22 CLASS B QP 230V/50Hz 100% LOAD
MARGIN: >10 dB

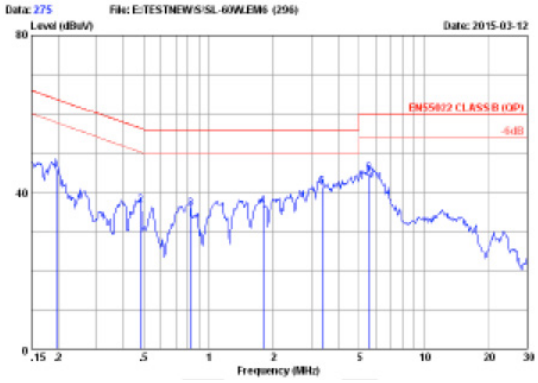


CISPR22 CLASS B AV 230V/50Hz 100% LOAD
MARGIN: >5 dB

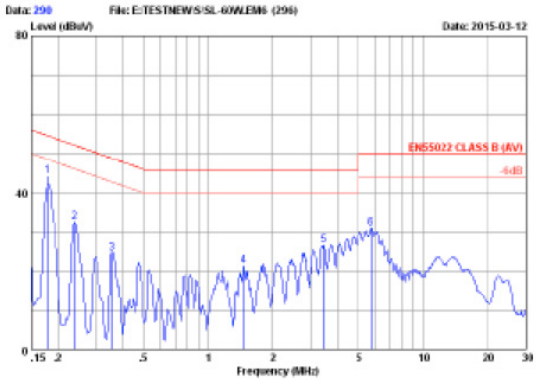
FCC15 CLASS B QP 120V/60Hz 100% LOAD
MARGIN: >20 dB

FCC15 CLASS B AV 120V/60Hz 100% LOAD
MARGIN: >18 dB

CE EMI 60W 24V CLASS I (F)



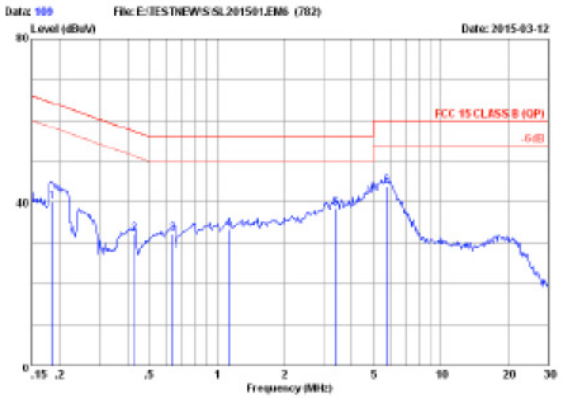
CISPR22 CLASS B QP 230V/50Hz 100% LOAD
MARGIN: >14 dB



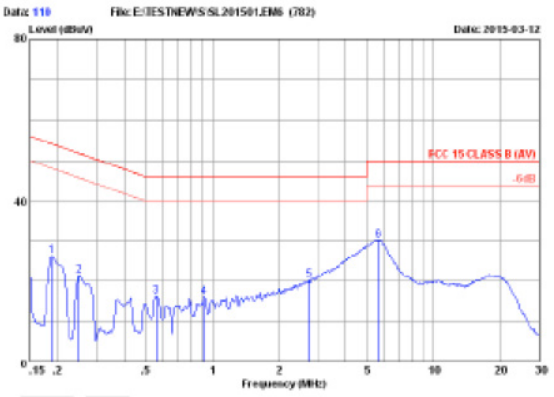
CISPR22 CLASS B AV 230V/50Hz 100% LOAD
MARGIN: >10 dB

Electromagnetic Interference Data

CE EMI 60W 24V CLASS I (F)

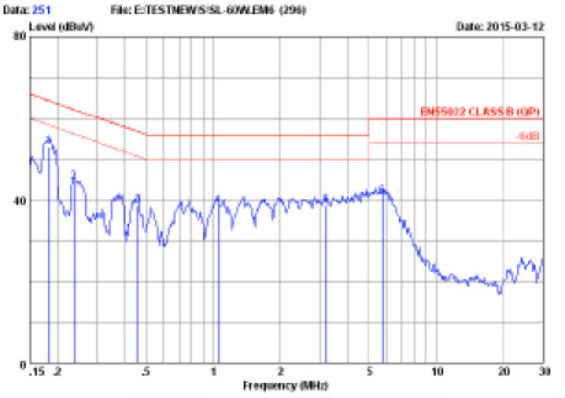


FCC15 CLASS B QP 120V/60Hz 100% LOAD
MARGIN: >16 dB



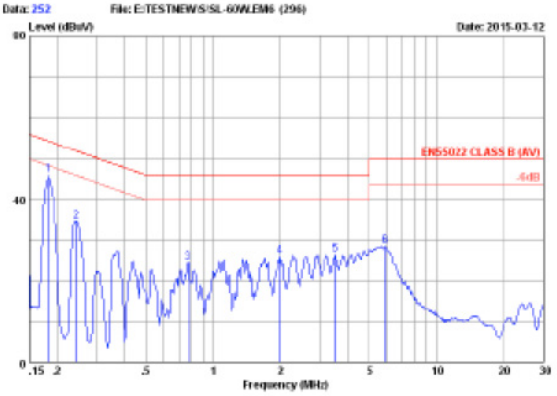
FCC15 CLASS B AV 120V/60Hz 100% LOAD
MARGIN: >19 dB

CE EMI 60W 24V CLASS II (N)



CISPR22 CLASS B QP 230V/50Hz 100% LOAD
MARGIN: >11 dB

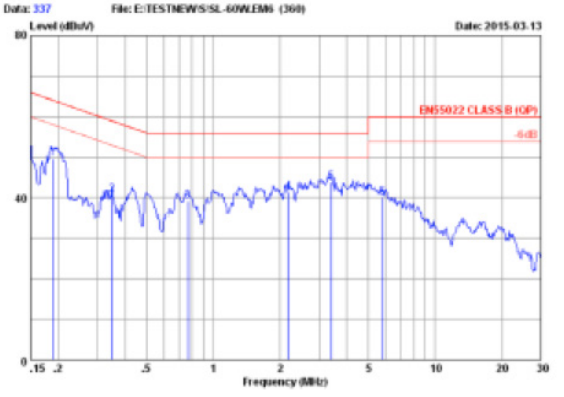
FCC15 CLASS B QP 120V/60Hz 100% LOAD
MARGIN: >16 dB



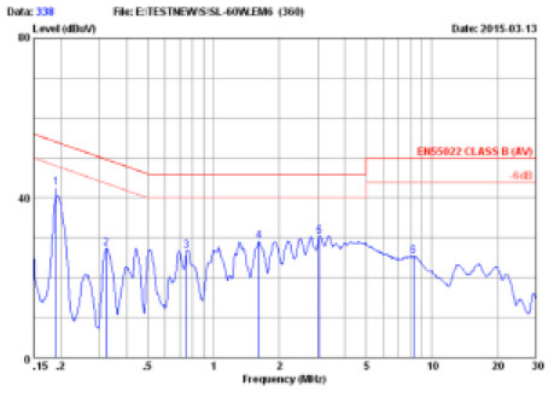
CISPR22 CLASS B AV 230V/50Hz 100% LOAD
MARGIN: >8 dB

FCC15 CLASS B AV 120V/60Hz 100% LOAD
MARGIN: >20 dB

CE EMI 60W 48V CLASS I (F)



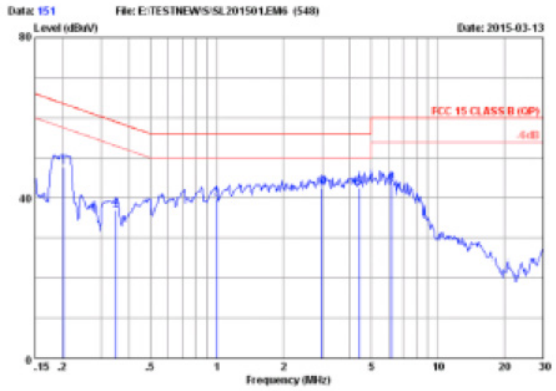
CISPR22 CLASS B QP 230V/50Hz 100% LOAD
MARGIN: >12 dB



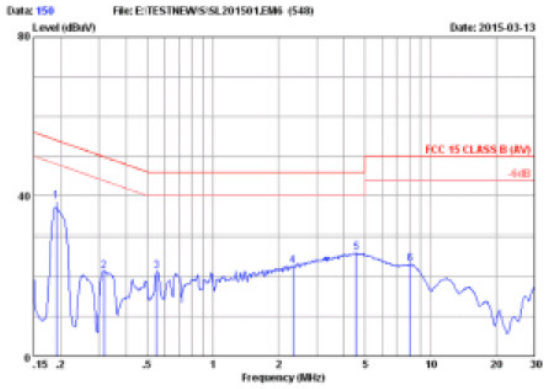
CISPR22 CLASS B AV 230V/50Hz 100% LOAD
MARGIN: >11 dB

Electromagnetic Interference Data

CE EMI 60W 48V CLASS I (F)

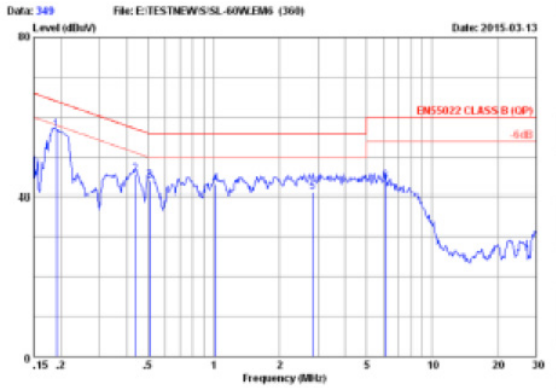


FCC15 CLASS B QP 120V/60Hz 100% LOAD
MARGIN: >13 dB



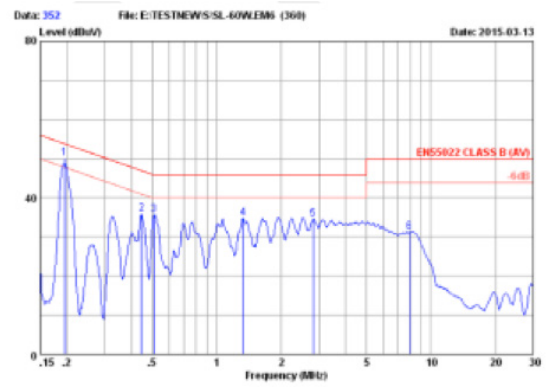
FCC15 CLASS B AV 120V/60Hz 100% LOAD
MARGIN: >15 dB

CE EMI 60W 48V CLASS II (N)



CISPR22 CLASS B QP 230V/50Hz 100% LOAD
MARGIN: >7 dB

FCC15 CLASS B QP 120V/60Hz 100% LOAD
MARGIN: >11 dB



CISPR22 CLASS B AV 230V/50Hz 100% LOAD
MARGIN: >3 dB

FCC15 CLASS B AV 120V/60Hz 100% LOAD
MARGIN: >11 dB

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